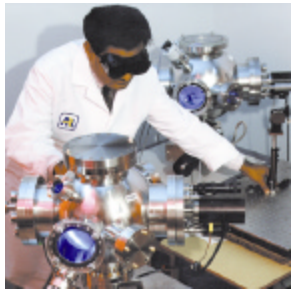
S&T Perspective of Transformation

NDIA 7th International Artillery & Indirect Fire Symposium & Exposition

Parsippany, New Jersey
18 June 2002

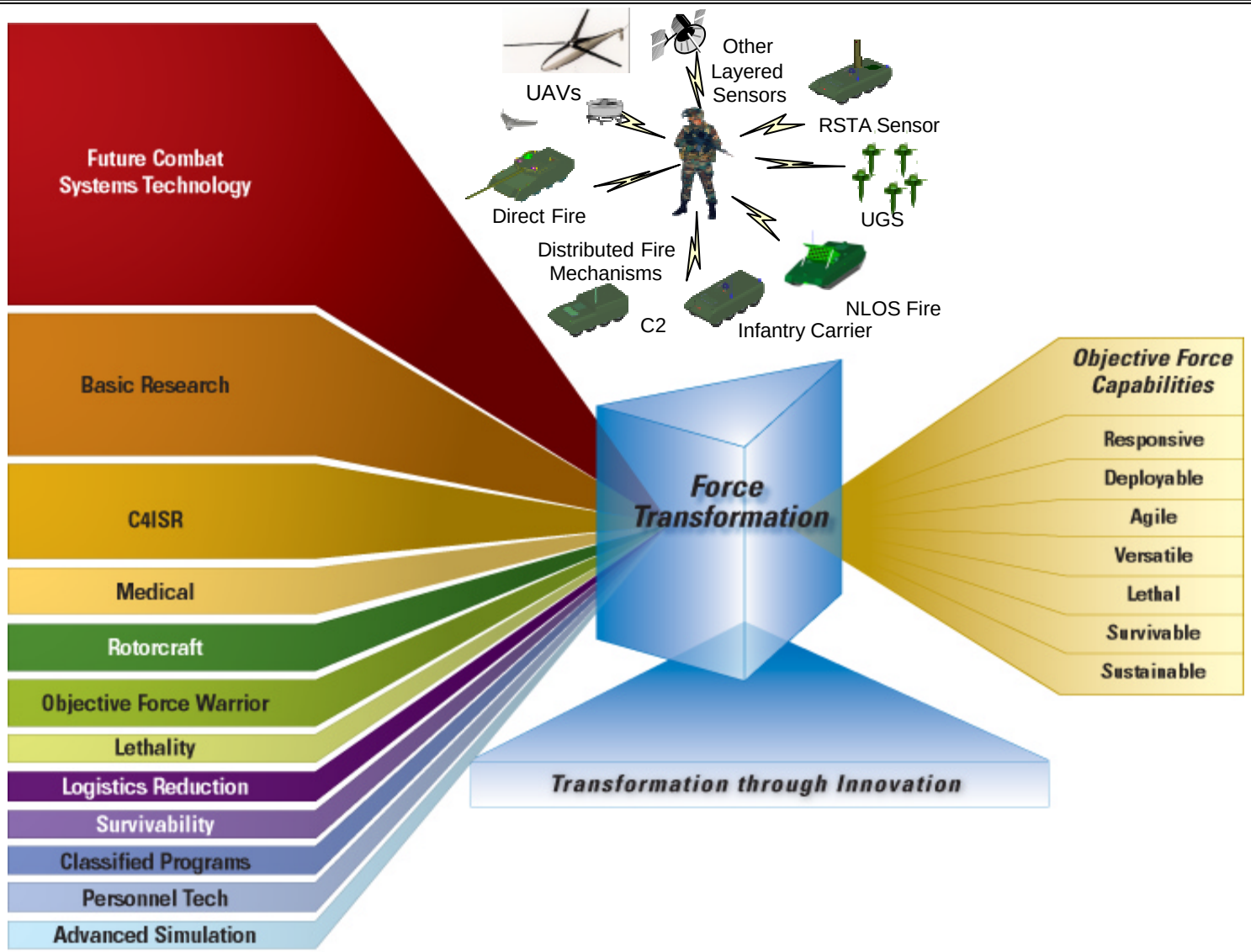


Dr. Marilyn M. Freeman
Office of Secretary of the Army
for Research and Technology
Deputy for Armament,Combat Vehicle &
Soldier Technologies

Outline

- *S&T Investment Strategy*
- *Technologies and Transformation*
- *Capability vs. Technology*
  - *Objective Force Warrior*
  - *Future Combat Systems*
- *Technology Transition*
- *FCS Concept Baseline*
- *FCS Effects Paradigm*
- *Key Effects Technologies*
- *Summary*

S&T Investment Strategy …Objective Force Technology Areas



Basic Research…Knowledge & Understanding for Continual Transformation

In the 70's…for Desert Storm

Night Vision

"Silver Bullet"

M829A1

Ultrahigh Strength Steel

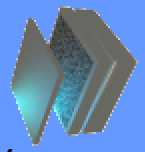
Special Armor

In the 80's…for FCS

Full Spectrum Active Protection

Uncooled IR

Vision and Control for Robotics



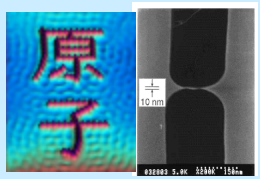
Electromagnetic Armor

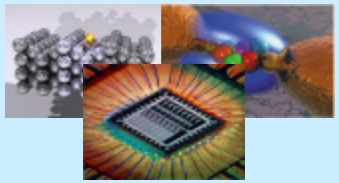
Today for 2015 and beyond…

Directed Energy

Robotics

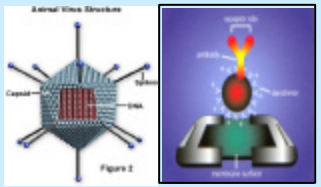
Nanotechnology





Advanced Computing

Immersive Environments

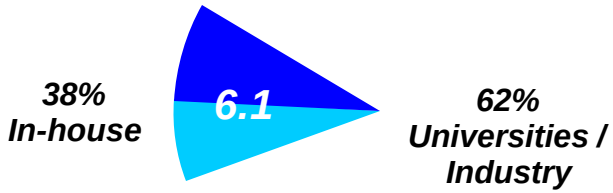


Biotechnology

Science for Land Warfare Dominance

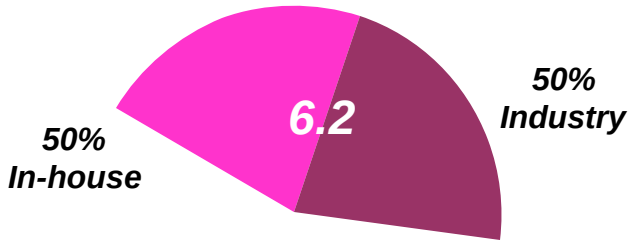
Technology & Transformation
From Ideas to Weapon Systems

Basic Research - Imaginable



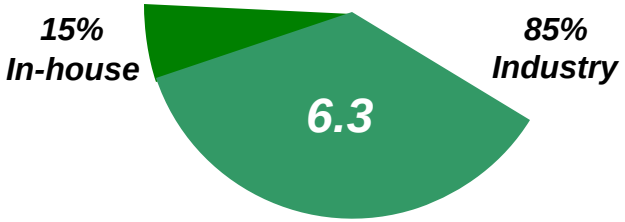
- Basic scientific studies with the potential to significantly change land warfighting capabilities
- Implemented through university, industry and in-house research
- Winning the Race for Speed and Precision with Transforming Technologies

Applied Research - Feasible



- Overcome technology barriers and mature options for specific military problems
- Focused on development of:
  - Components, Models, New Concepts
- Enable upgrades for Objective Force
- Implement through Industry and In-House Research

Advanced Technology - Demonstrable Development



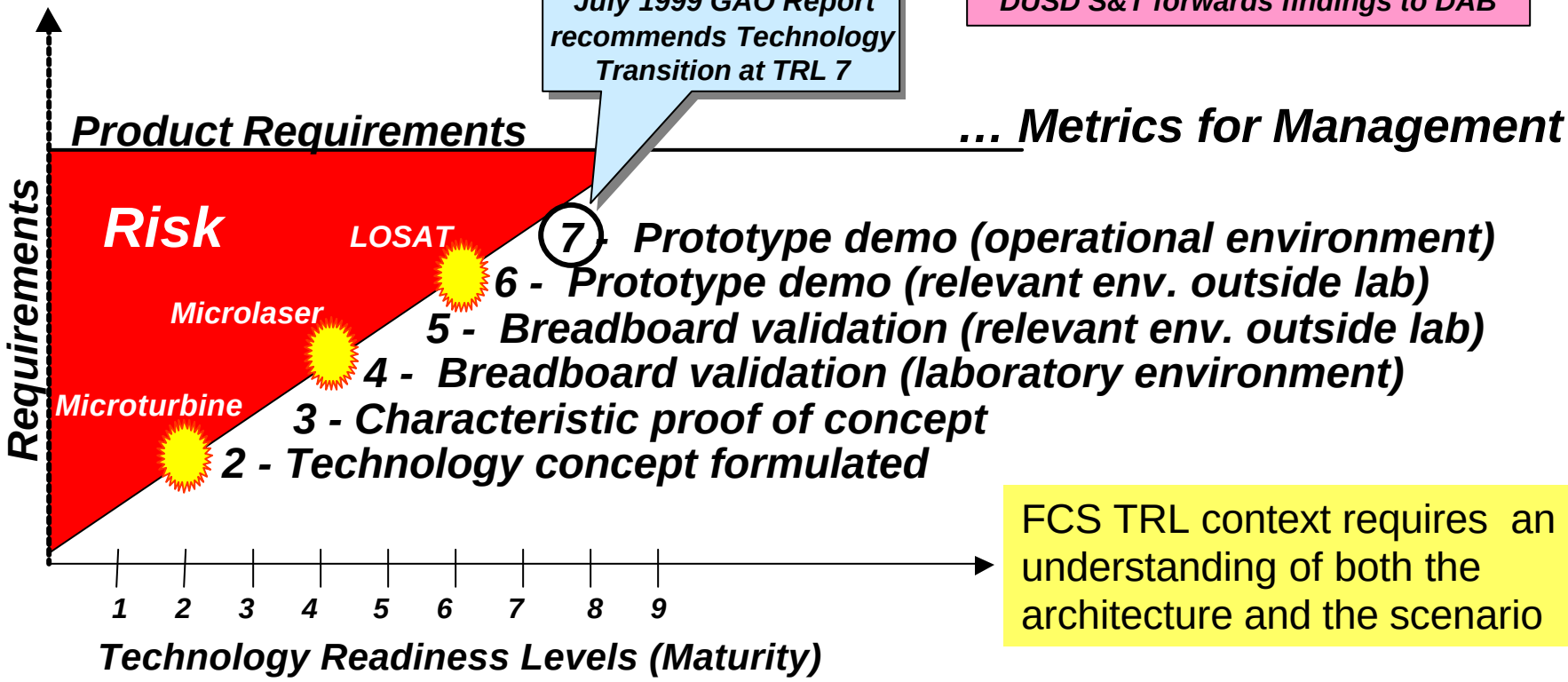
- Demonstrate technical feasibility at the system and subsystem level
- Focus on Objective Force Technology Opportunities
- Increase Technology Readiness for FCS Demonstrations and SDD Block Upgrades
- Implemented through Industry

Technology Readiness Levels (TRLs)… A Metric for Transition

For FCS, TRL's represent metrics that indicate System Technology Maturity and Readiness to Transition to Development

DoD 5000.2-R Requires Component S&T Executive to conduct Technology Readiness Assessment for ACAT 1 Programs at MS B & MS C -- DUSD S&T forwards findings to DAB

July 1999 GAO Report recommends Technology Transition at TRL 7



FCS TRL context requires an understanding of both the architecture and the scenario

Warfighting Capability vs. Technical Capability

Systems & How to Fight Them

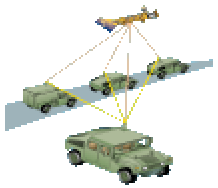
- ***TRADOC "CHUNKS"***
  - LOS/BLOS
  - NLOS Lethality (Networked Fires)
  - Survivability
  - CM/Counter Booby Trap
  - Mounted Dismounted Maneuver
  - Battle Command Construct
  - Sensor Fusion
  - Air-Ground Ops
  - Training & Leader Development
  - Human Engineering
  - Maneuver Sustainment
  - Deployability

Technologies & How to Apply Them

- ***S&T "BINS"***
  - Lethality
    - LOS/BLOS
    - LOS
    - BLOS
    - NLOS
  - Survivability
  - Mobility
  - C4ISR
    - C4
    - ISR
  - Robotics
  - Training
  - Human Engineering
  - Medical
  - Sustainment

Objective Force Warrior Technology Options

Signature Management

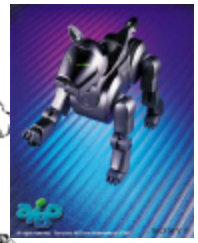


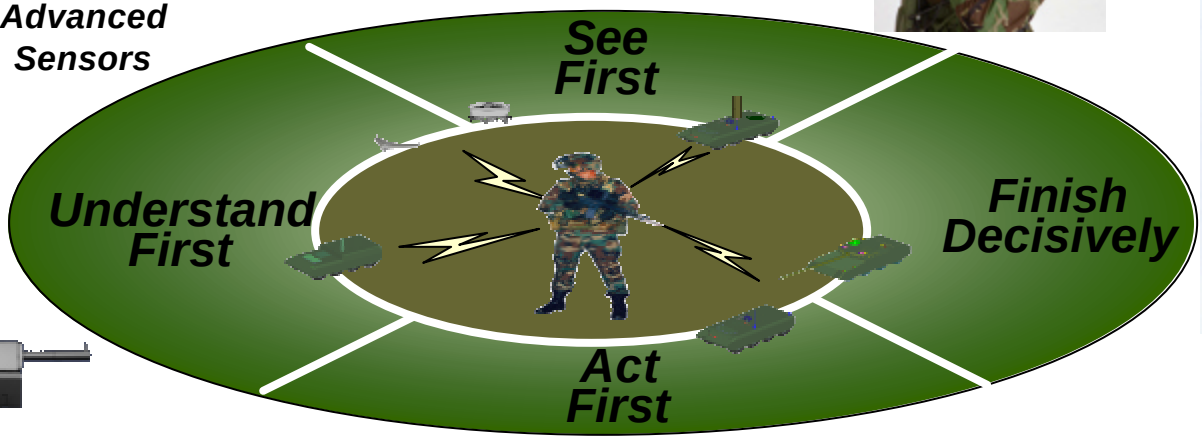
Connectivity to Objective Force C4ISR

Water Purification & Generation

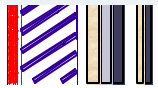
Exoskeleton

Advanced Sensors





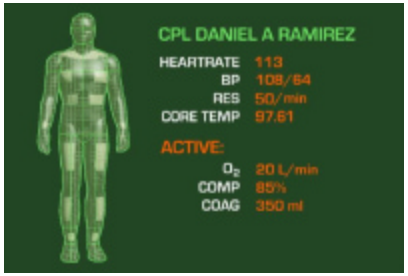
Agile Lethality Effects



Advanced Armor

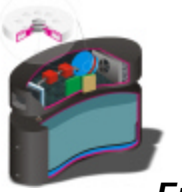
Robotic Mule

Armed UAV



Physiological monitor and Causality Combat Care

Micro UAV



Fuel Cells

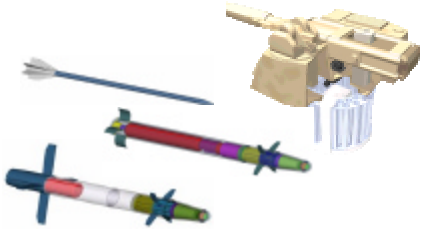
Options to Achieve Revolutionary Capabilities

Future Combat Systems Technology Options

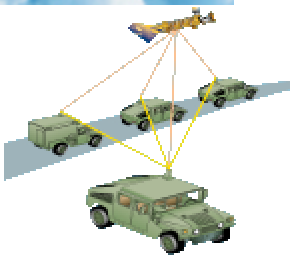
UAV RSTA / Comm Relay

Adv. Sensors

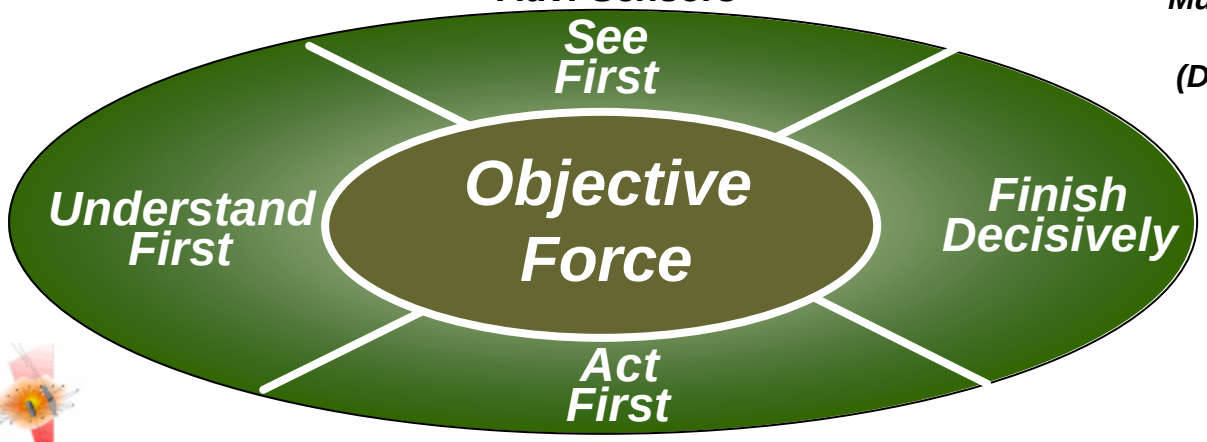
Follower UGV

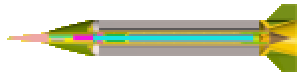


Multi-Role Armament & Ammo Suite (Direct & Indirect Fire)

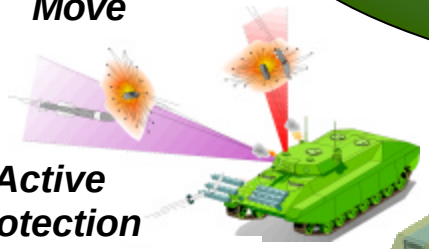


C3 On the Move

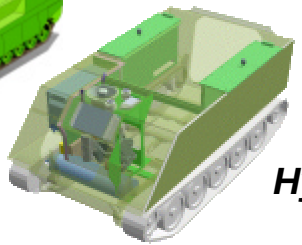




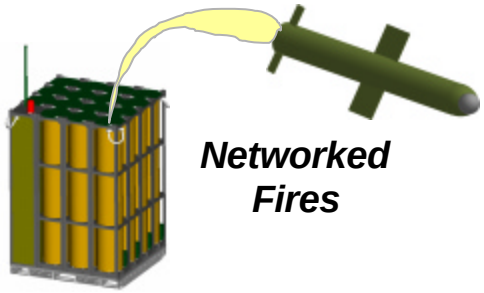
Compact Kinetic Energy Missile



Active Protection

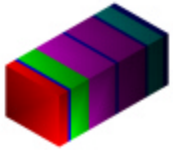


Hybrid Electric Propulsion



Networked Fires

OCSW

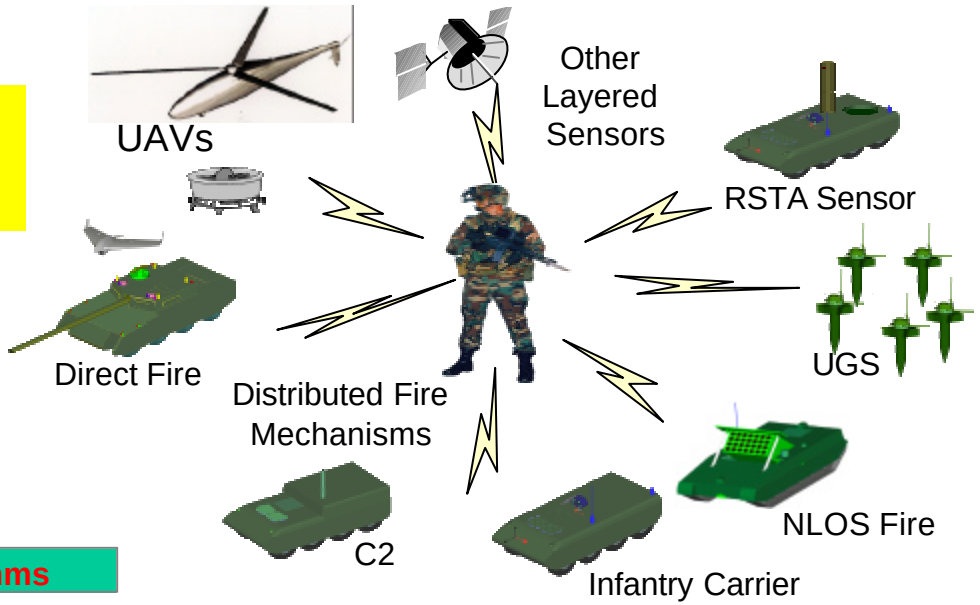


Integrated Armor

Technologies to Build FCS in this Decade

FCS Concept

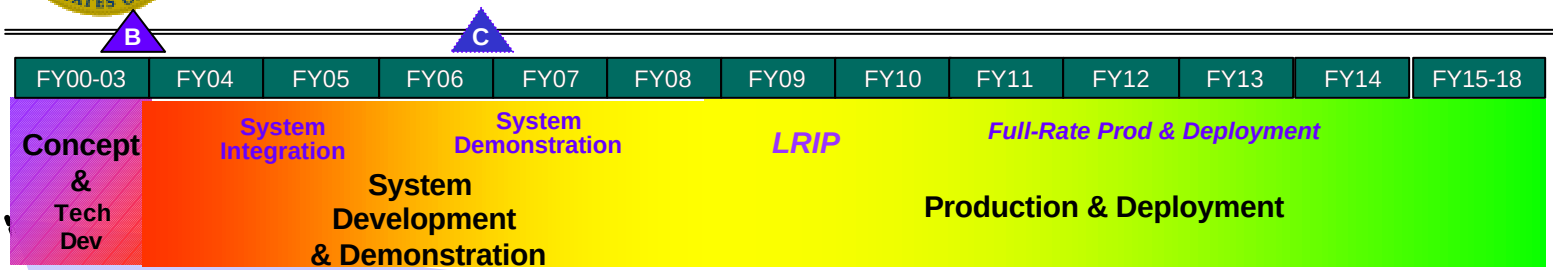
FCS is the Catalyst for Army Transformation



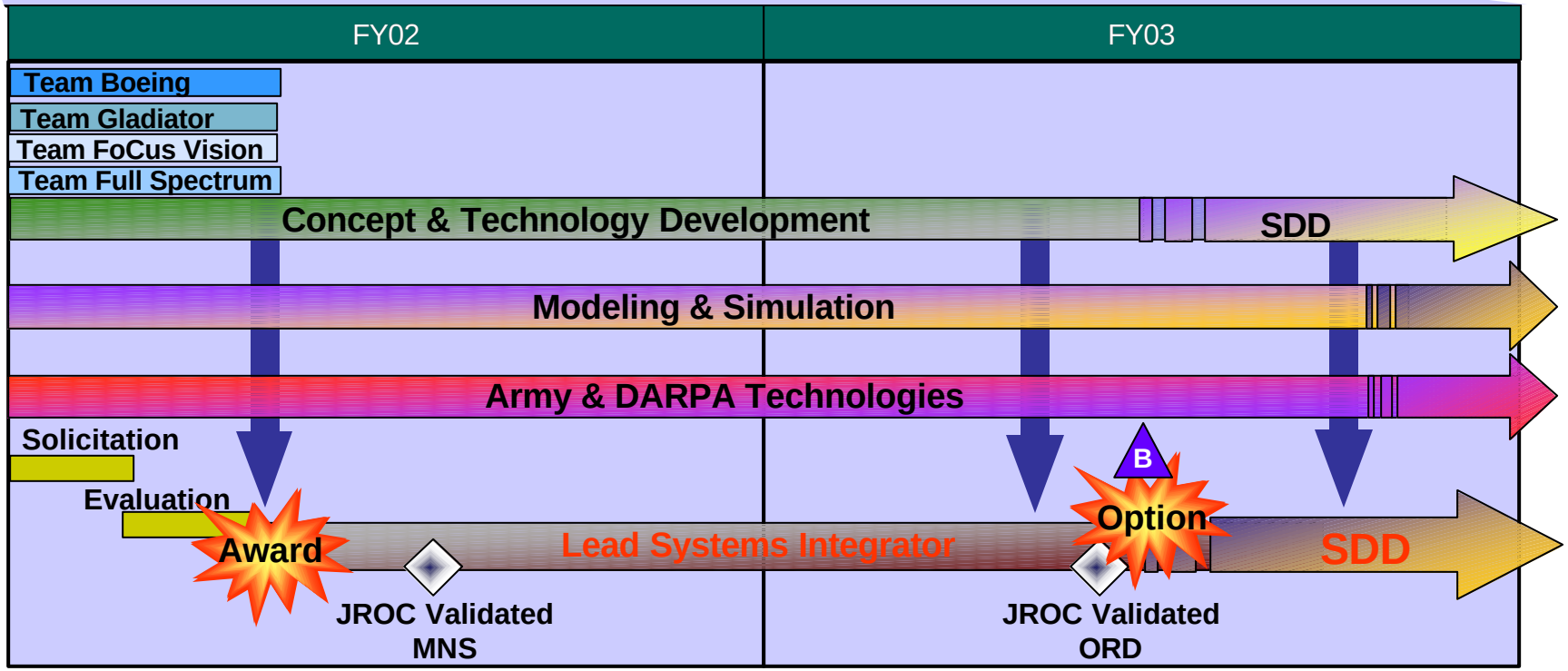
- Future Combat Systems System of Systems
  - NETWORK
    - Backbone
    - Comms
  - Platforms
    - Ground
      - Manned
      - Unmanned
    - Air
      - Micro UAV
      - Organic UAV
      - High Endurance UAV
  - Effects
    - Lethal
      - NETFIRES
    - Non-Lethal
  - C2
    - Interfaces
    - Embedded Trng
    - Mission Planning
    - Mission Rehearsal
  - Sensors
    - EO/IR
    - UGS
    - SAR
    - Sigint
  - Support Systems
    - Soldier Systems
      - Objective Force Warrior
    - Platforms

FCS is a System of Systems

FCS Acquisition Timelines Influence Technology Transition & Insertion Options



Schedule is extremely aggressive …. forcing new requirements and acquisition business models



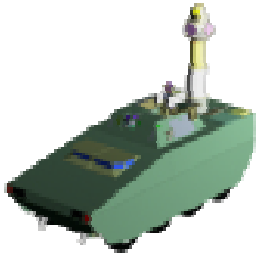
Future Combat Systems Baseline ….“the .75 Concept”

Manned Ground Platforms

155mm resupply

SUAV carrier

155 mm NLOS



Reconnaissance and surveillance

APC, C2, CV, RV

120 mmBLOS/LOS

Unmanned Air Platforms

Tube-launched small UAV

Organic air vehicle OAV

TUAV

Combat Robots

Armed reconnaissance

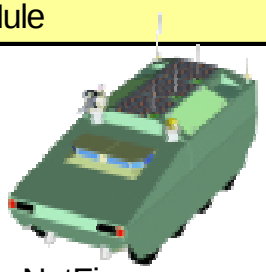
Soldier Robots

Tracked

Legged

Mule

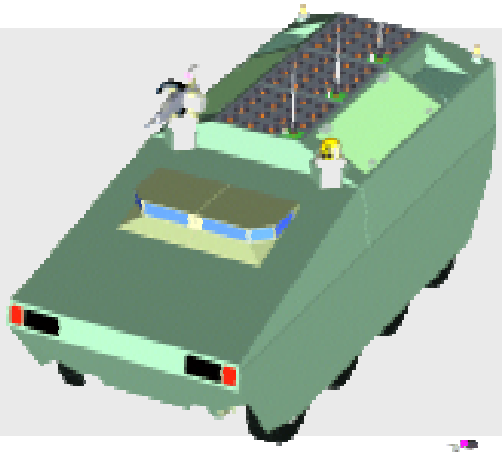
120 mm Mortar



NetFires

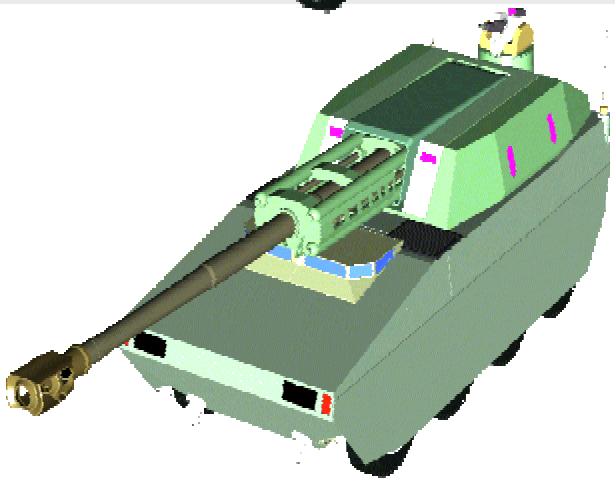
A Family of Highly Capable Combat Systems

FCS Non-Line-Of-Sight (NLOS) Baseline Weapons Platforms



NetFires vehicle

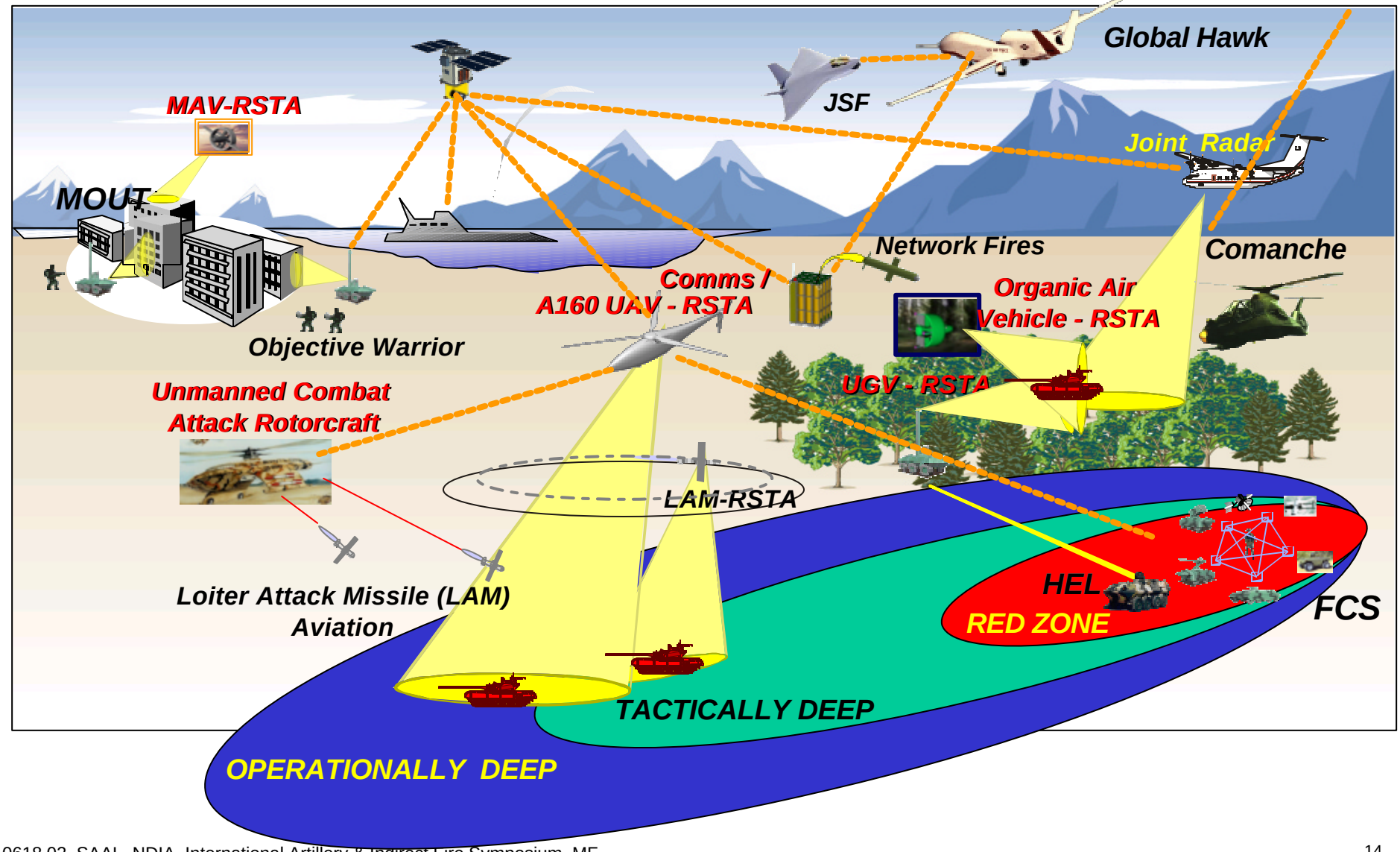
- Combat and airlift w eight: 16.2 tons
- Crew size: 2 (robotic follower P3I)
- NetFires missiles
  - 3 each 15-round pods
  - 45 ready rounds
  - Precision attack missiles (30-km range)
  - Loitering missiles when available (LAM)



NLOS vehicle—155 mm cannon

- Combat w eight: 21.4 tons
- Airlift weight: 18.0 tons
- Crew size: 2 (driver and commander)
- Remote w eapon station
- 155 mm
  - Azimuth: 360 deg
  - Elevation: +60 deg, –10 deg
- 5-round drum with rammer
- 30 rounds in hull magazine
- Rate of fire: 10 rpm for 5 rounds, 6 rpm for 30 rounds
- Range: 30 km

Seizing Technology Opportunities…
Revolutionary Effects Capabilities



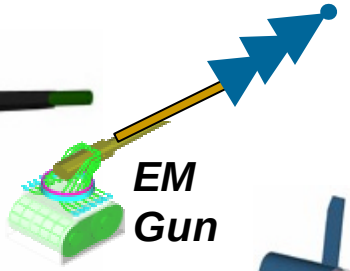
The "Effects Paradigm Shift"

(CSA Objective Force White Paper 10 October 2001)

"Objective Force units will conduct operational maneuver from strategic distances, creating diverse manifold dilemmas for our adversaries by arriving at multiple, unimproved points of entry, forcibly if necessary; overwhelming aggressor anti-access capabilities; and rapidly imposing our will on our opponents. In this manner, Objective Force units will arrive immediately capable of conducting simultaneous, distributed and continuous combined arms, air-ground operations, day and night in open, close, complex, and all other terrain conditions throughout the battlespace. Army units conducting joint and combined operations will *see first, understand first, act first and finish decisively* at the strategic, operational, and tactical levels of operation."

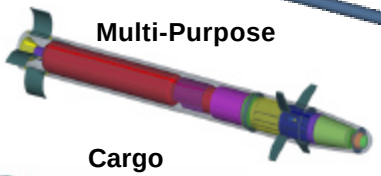
Maintain the Advantage to Engage, Defend and/or Suppress…

FCS Weapons Mix

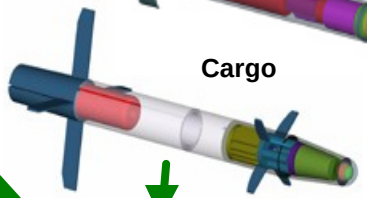


EM Gun

Kinetic Energy



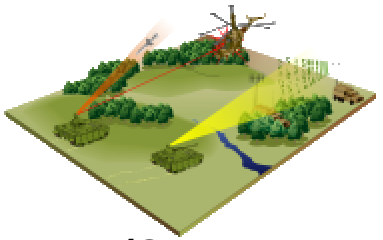
Multi-Purpose



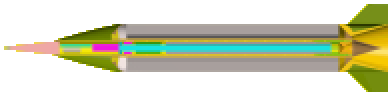
Cargo

Multi-Role Armaments
(120 mm / 105 mm)

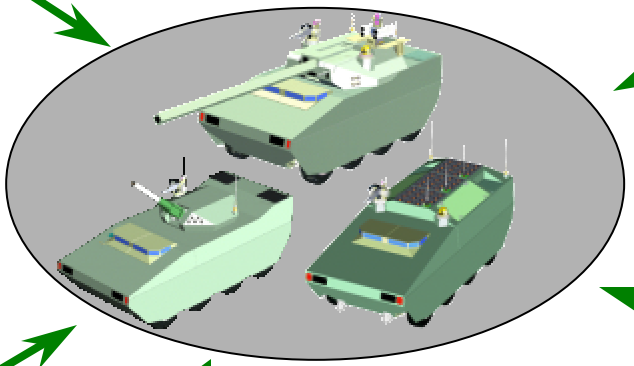
Multi-Role Ammo
(120 mm / 105 mm)

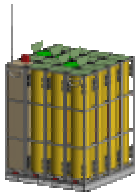


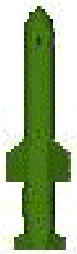
HPM/Compact Lasers



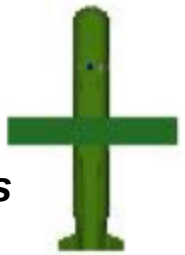
Compact Kinetic Energy Missile (CKEM)





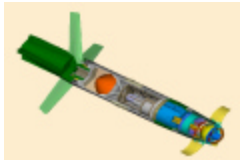


NetFires

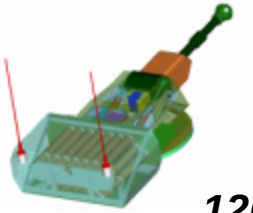


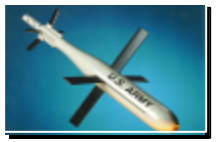
Precision Attack
(40 km)

Loiter Attack
(100 km, 45 min)



TERM





120 mm Mortar

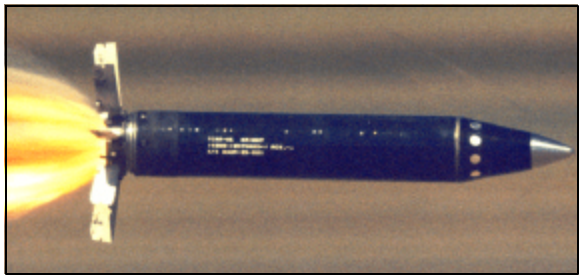
OICW

Extended Range Networked Fires

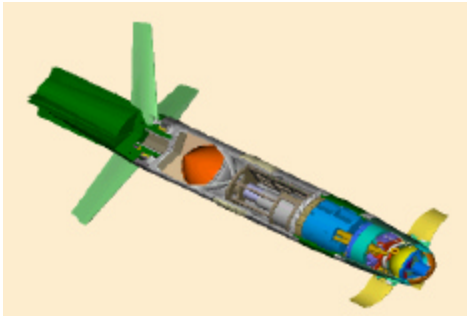
Determined by Availability, Scenario, Environment, Performance & Cost

FCS Options: Guns /Gun-Tube Launched Munitions

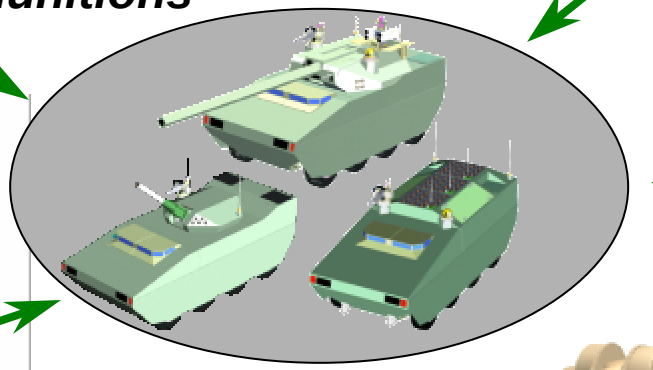
Precision Guided Mortar Munitions

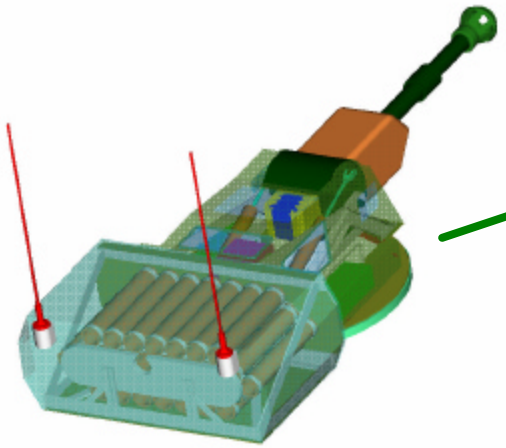


Tank Extended Range Munitions - KE



Tank Extended Range Munitions - CE





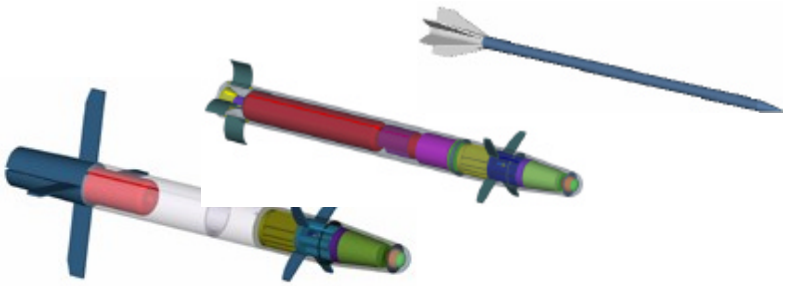
Remote Autonomous Mission Module (120 mm Mortar)

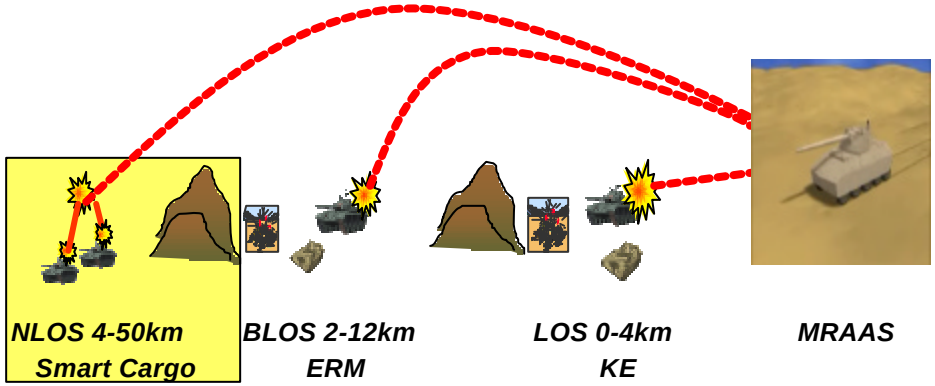
MRAAS

(120 mm / 105 mm)

Objective Crew Served Weapon

Long-Range Precision: Guns





Provides:

- ***Acceleration of Multi-Role Smart Cargo Round***
- ***Smart Anti-Vehicle Mines for Active Barrier System***
- ***Revolutionary Warheads***
- ***Advanced energetic materials***

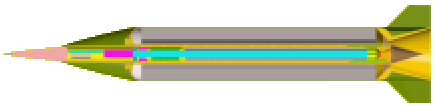
Payoffs:

- ***Increased FCS survivability – "See first … finish decisively"***
- ***Increased armor penetration, in smaller warheads***
- ***Increased area coverage with fewer mines***

Lethal Effects at Long Range, with Greater Stand-Off for FCS

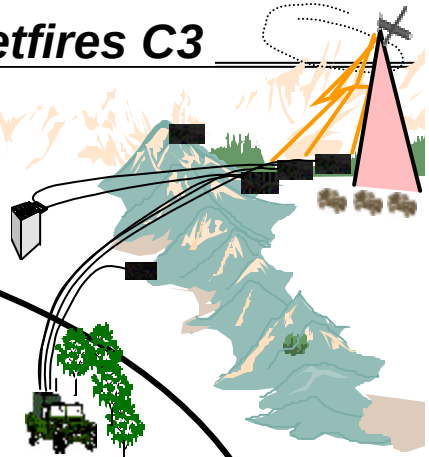
FCS Options: Missiles

CKEM

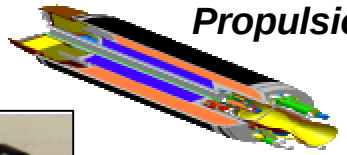


Common Missile

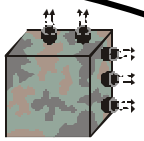
Netfires C3



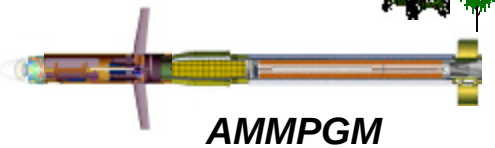
Controllable Thrust Propulsion



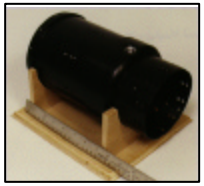
Conformal Optics



Fire Control

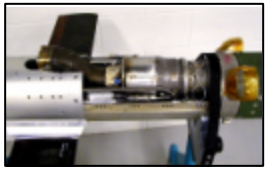


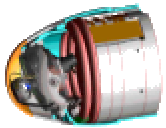
AMMPGM



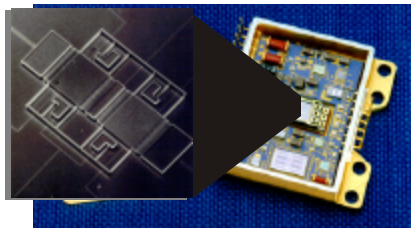
Data Links/ Networking

Turbojet Engine



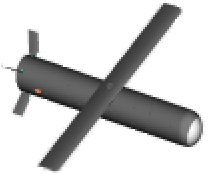


Multi-Mode Seeker



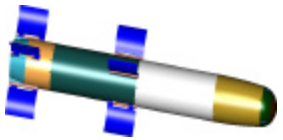
MEMs IMU

LAM



LCPK

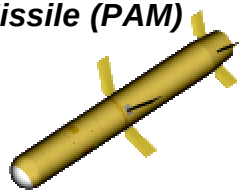
LAM-A

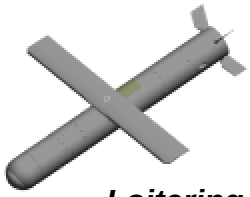


PAM

Long-Range Precision: Missiles

Precision Attack Missile (PAM)





Loitering Attack Missile (LAM)

- *Vertically launched, lock-on-after-launch PAM (range 50km) and LAM (range >50km w/30 minute loiter).*
- *Ground observer-to-shooter-decider for single missile w/in-flight updates (Minimal C2)*

NetFires

Provides:

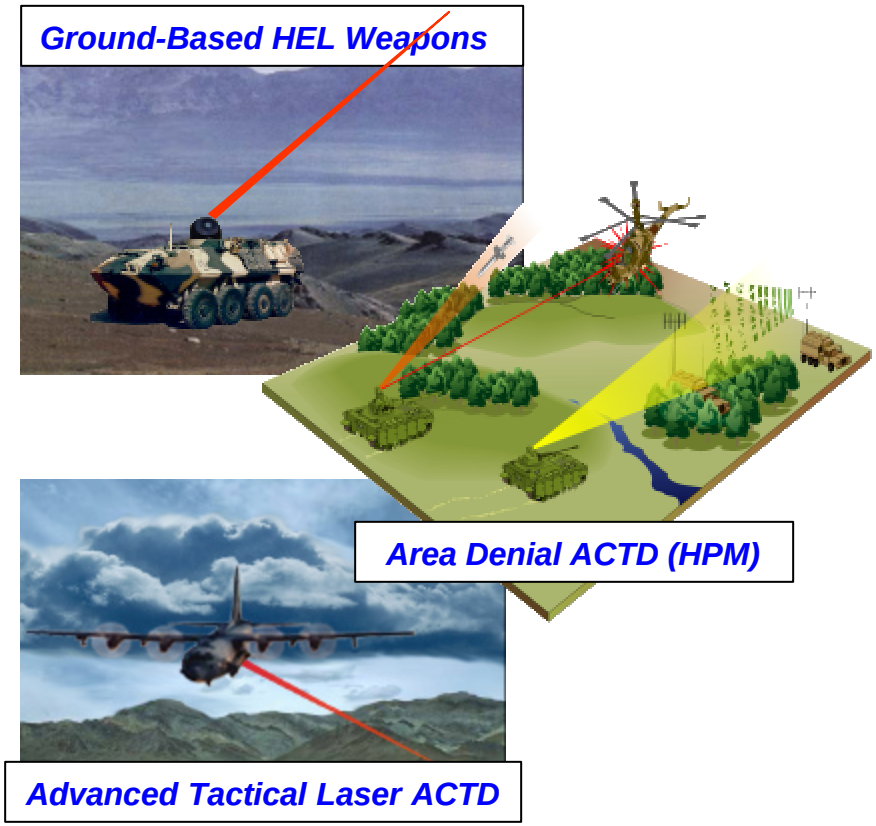
- **Immediate firepower**
- **5x-10x kills per ton vs. current ordnance**
- **Multimode seekers**
- **In-flight targeting**

Payoffs:

- **Large zone of influence**
- **Can provide BDA and imagery**
- **Reduced latency**
- **Versatility: Not platform specific**

Directed Energy Weapons (DEW)

Speed of light engagement for the tactical battlefield



Provides:

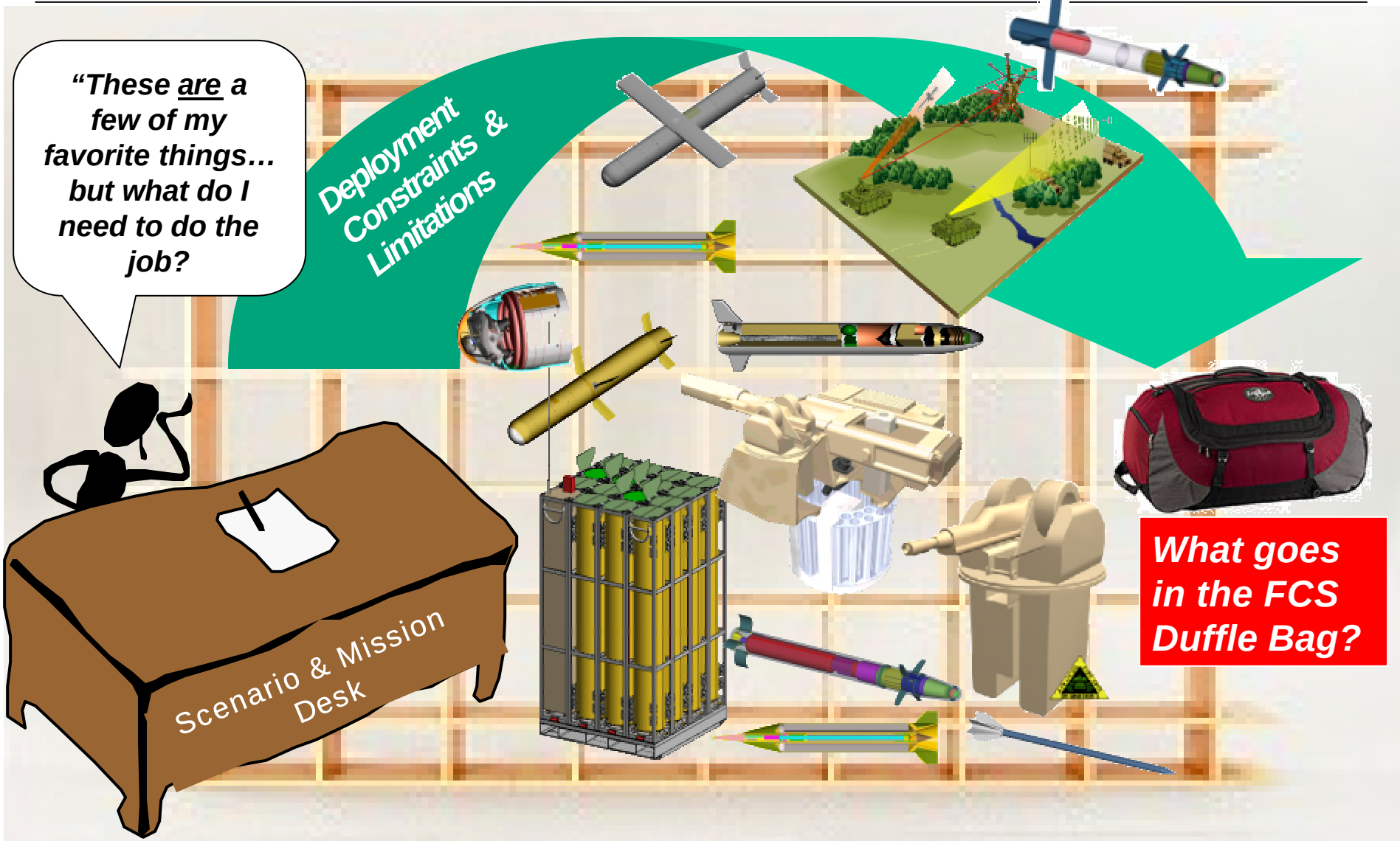
- *Solid-state fiber laser technology*
- *High-powered microwave (HPM) technology*
- *Modular high energy laser (HEL) system*

Payoffs:

- *Near-term demonstration of modular Chemical Oxygen Iodine Laser (COIL) system*
- *Alternative solid state HEL approach for FCS Block upgrade*
- *Demonstrate non-lethal HPM technologies*

"Suppression no longer has to be metal rain"

Selecting the right mix of FCS Effectors Is both challenging and critical!



Back-Up

FCS Acquisition Concept

Threshold Objective Force Capability (IOC) in FY2010